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To: Mr. J.H.P. Buckingham
Supervisor
Ash and Waste Management
Supply Division

CANADA BRICK QUARRY ASH LANDFILL - GROUNDWATER MONITORING AND CONTROL SYSTEM MODIFICATIONS - 1989

C.B. Cragg

Groundwater sampling wells were installed in the shale upstream of the ash landfill to replace wells destroyed by local construction. New sampling wells were installed in ash in the south end of the landfill. Modifications were made to sumps attached to the emergency underdrainage system to improve long term durability. Details of these installations and modifications are provided herein.

1.0 BACKGROUND

As part of the licensing agreement for the ash landfill at the Canada Brick site, an underdrainage system was required so that leachate from the landfill could be extracted and treated if the need arose. The underdrainage system includes a main sump and two intermediate sumps as shown in Figure 1. Now that the ash fill has been completed and work on the upper seal layer and its protective cover is well advanced, there is no continuing need for the intermediate sumps. The corrugated pipe used in the main sump was showing signs of deterioration. Rehabilitation of the main sump for long term use and backfilling of the intermediate sumps are described.

A network of groundwater monitoring wells was also required in the licensing agreement. Four wells had been located north of the site to provide background data on the water quality in the shale. Recent construction of a subdivision in this area has rendered these wells inoperable. The locations and construction of these replacement wells are described.

Water samples obtained from the main sump are currently being characterized as leachate and are being used to gauge the influence of the landfill on groundwater adjacent to the site. The sump water chemistry differs significantly from ash leachate measured at other projects so it is believed that the leachate has been diluted by groundwater originating in the shale at this point. Additional sampling wells were installed in the ash in the vicinity of the main sump. Construction of these wells is also described.

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2.0 SUMP REHABILITATION

Backfilling of the intermediate sumps had to meet two objectives: (1) maintain the high quality of the structural landfill and (2) avoid plugging the underdrainage system. Rounded, uniform grain size fill materials were selected to achieve the best fill density without compaction. Compaction could not be applied due to the high water levels in these wells. A cap of sand/cement grout was poured on top of the fill materials. Pea gravel was placed at the bottom of these sumps to limit fill ingress into the drainage system. The sumps are connected to the main drainage pipes by a 10 cm diameter branch line. Concrete sand was placed above the pea gravel to act as a filter for the grout. The thicknesses of fill materials used in these two sumps is shown in Figure 2.

To ensure long term performance of the main sump, a thick walled plastic (approximately 15 mm) pipe liner was grouted inside the original bitumen coated steel culvert. Pea gravel and a concrete sand filter were placed in the annular space between the pipes to prevent grout intrusion into the drainage sump gravel. Water was drawn down in the central pipe and recirculated down the annular space to facilitate the sand placement prior to grouting. Figure 3 shows the liner construction. Figure 4 gives details of the gravel, sand and grout material locations.

3.0 GROUNDWATER SAMPLING WELLS

Four new groundwater sampling wells were installed south of the railway tracks and northwest of the quarry to provide background water quality data for the fly ash landfill. Elevation details for these wells, labelled 2C, 2D, 7A and 7B are given in Table I and locations are shown in Figure 1. These wells replace wells labelled 2A, 2B, 6 and 7 in Figure 1, which have been rendered unusable by subdivision construction north of the railway tracks and north of the quarry. Elevations of these original wells are also contained in Table I.

In previous landfill projects, water samples from a sump in the landfill were frequently used to represent the leachate generated by the ash fill materials. Samples from wells around the periphery of the landfill are compared to the sump reference chemistry to determine the extent and amount of leachate migration. A review of the sump water chemistry at the Canada Brick quarry suggested the ash leachate at this location is being diluted by groundwater emerging from the surrounding shale. Three wells were installed at various depths in the ash near the sump to provide better data on the leachate chemistry. The locations of these wells are shown in Figures 1 and 5. Elevation information is again shown in Table I. Standard penetration tests performed while drilling these wells gave "N" values exceeding 40 blows per 0.3 m (Figures 6 to 8) indicating that the ash and overlying seal materials have been compacted to a dense state suitable for supporting the proposed future building planned for this site. These tests confirm the quality control test results at the site and shows that the ash, in particular, has been well compacted with all "N" values in the very dense range (ie greater than 50 blows per 0.3 m).

4.0 SUMMARY

The installation of groundwater monitoring wells and alterations to the underdrainage system for the ash landfill at the Canada Brick quarry have been described. Strength testing on the ash landfill indicates it is a suitable foundation for future building on this site.

Approved by:

T.W. Klym
Manager
Civil Research Department

Prepared by:

C.B. Cragg
Senior Engineer
Soil Sciences Section

Reviewed by:

T.J. Carmichael
Supervising Engineer
Soil Sciences Section

CBC:LM

TABLE I

Groundwater Sampling Well Elevations

(A) Replacement Wells - installed July 1989

Well Number	Ground Elevation (m)	Top Elevation (m)	Depth (m)	Tip Elevation (m)
2C	143.65	143.99	18.0	125.6
2D	143.65	144.26	12.1	131.5
7A	143.11	143.73	7.6	135.5
7B	143.11	143.59	17.8	125.3

(B) Original Wells

Well Number	Top Elevation (m)	Depth (m)	Tip Elevation (m)
2A	138.5	15.2	123.3
2B	138.5	7.6	130.9
6	142.1	9.2	132.9
7	145.8	8.8	137.0

(C) New Wells (in ash) - installed July 1989

Well Number	Ground Elevation (m)	Top Elevation (m)	Depth (m)	Tip Elevation (m)
1A	120.99	121.78	10.0	111.0
1B	120.99	121.65	4.6	116.4
1C	120.99	121.62	7.4	113.6

FIGURE 1
LOCATION OF SUMPS AND WELLS

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89-296

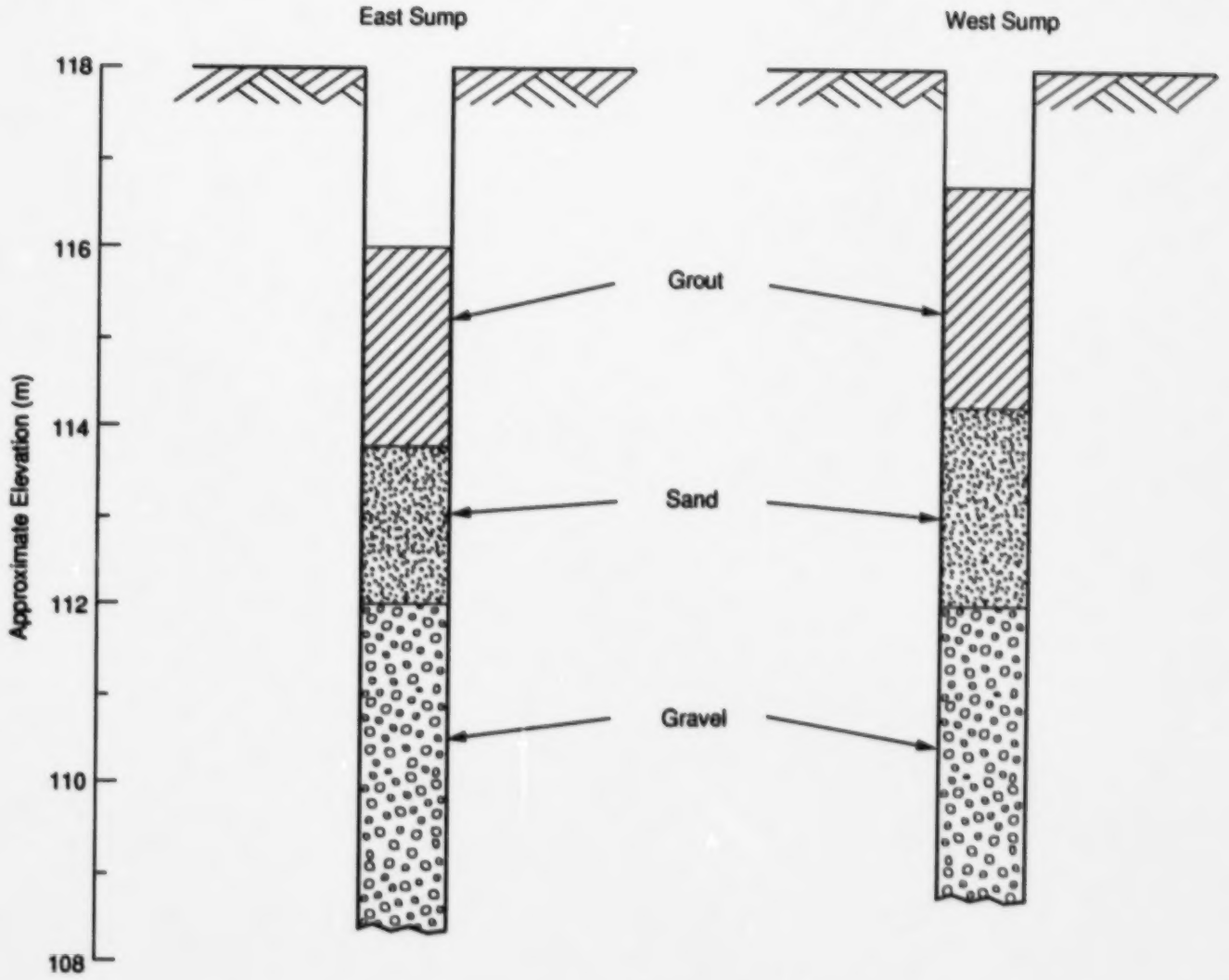

FIGURE 2

DETAILS OF INTERMEDIATE SUMP BACKFILLING

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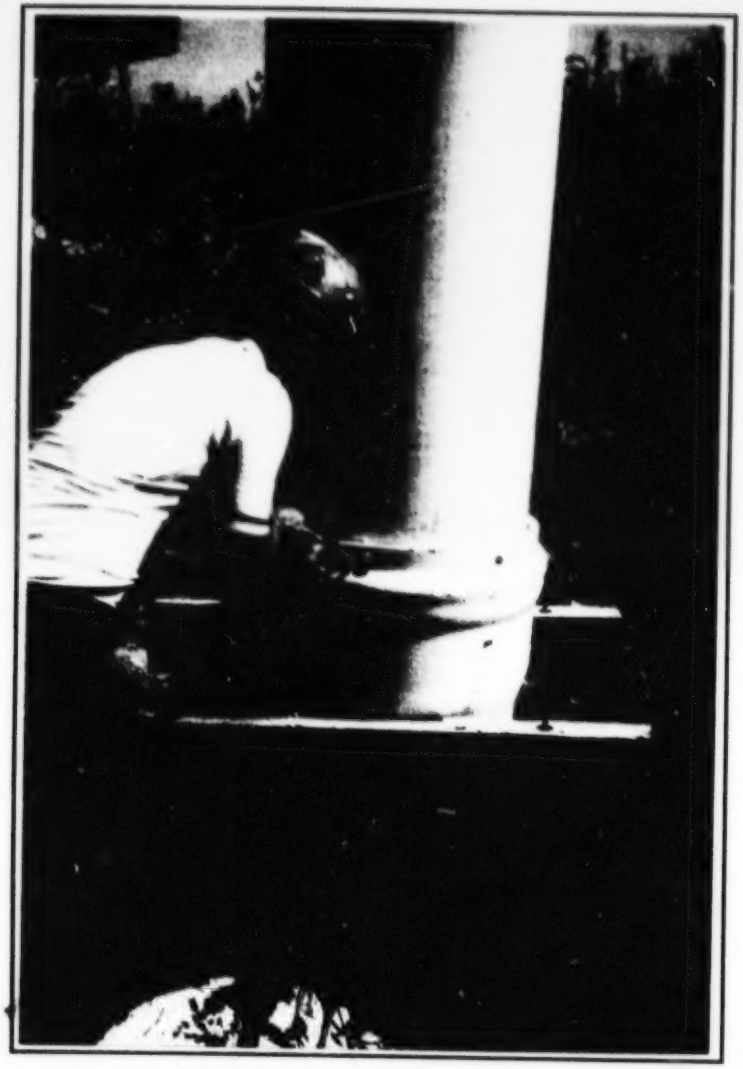

(A) Bell & Spigot Joint on Plastic Liner at Mid Height

(B) Annular Space Between Liner and Original Steel Culvert Prior to Grouting

FIGURE 3

CANADA BRICK QUARRY - MAIN SUMP

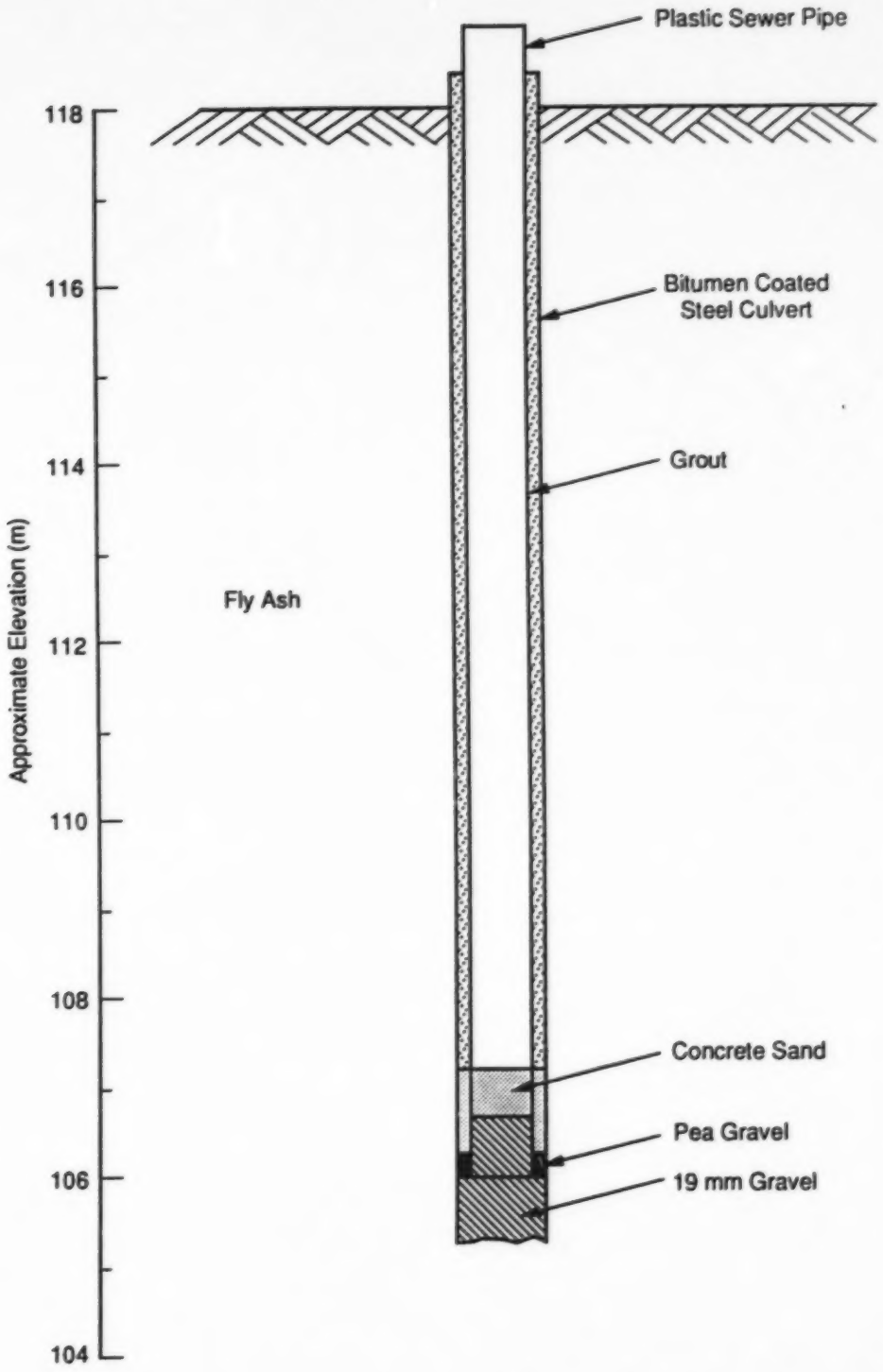

FIGURE 4

DETAILS OF MAIN SUMP REHABILITATION

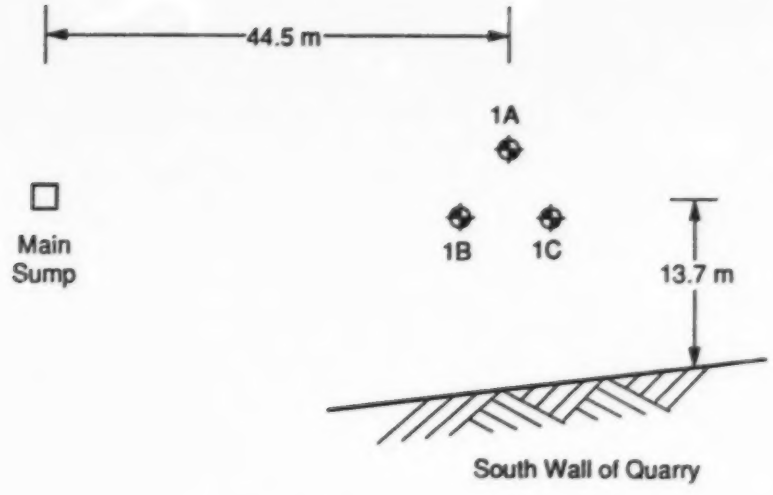

FIGURE 5

LOCATION OF NEW WELLS IN ASH

PROJECT CANADA BRICK QUARRY
LOCATION SEE FIGURES 1 AND 5
DATUM 120.99 m
DIP
BEARING

HOLE TYPE FLYTE AUGER
HOLE SIZE ø 1/2"
DRILLED JULY 14/83
DRAWN

OBSERVER MG
COMPILED CBC
CHECKED
APPROVED

BORING DATA						BORING LOG	WATER INF.		FIELD TESTS		LABORATORY TESTS					
SCALE - METRES	ELEV / DEPTH	SAMPLE NO	SAMPLE TYPE	'N' VALUE per 0.3m / ROD - %	WATER LEVEL and CAVING	DESCRIPTION / REMARKS	OBSERVATION WELL DATA	'K' cm/s / WATER PRESS TEST	SPECIAL TESTS TYPE	SPECIAL TESTS RESULTS	NATURAL DENSITY kg/m³	MOISTURE CONTENT - %	SHEAR STRENGTH kPa TYPE	SHEAR STRENGTH kPa RESULTS	SPECIAL TESTS TYPE	SPECIAL TESTS RESULTS
1						FILL, clayey silt (till), grey, some sand, little fine gravel, hard										
2		1A		73												
3		2A		48												
						3.8 m										
4						FILL, fly ash, black, very dense											
5		3A		81												
6		4A														
7																
8		5A		81												
9																
10		6A		50/0.1m												
						10.0 m										
11						END OF BOREHOLE										
						Note: Ground water sampling well installed to 10 m depth. (Top of well = 121.78 m)										

GEOTECHNICAL DATA SHEET

hole no 1A

Fig 6

sheet 1 OF 1

201034-RD

PROJECT CANADA BRICK QUARRY — HOLE TYPE FLYTE AUGER — OBSERVER MG

LOCATION SEE FIGURES 1 AND 5 — HOLE SIZE 4 1/2" — COMPILED CBC

DIP — DRILLED JULY 14/89 — CHECKED

DATUM 120.99 m — BEARING — DRAWN — APPROVED

BORING DATA						BORING LOG	WATER INF		FIELD TESTS		LABORATORY TESTS					
SCALE - METRES	ELEV / DEPTH	(1) SAMPLE NO	(2) SAMPLE TYPE	(3) 'N' VALUE per 0.3m / ROD-%	(4) WATER LEVEL and CAVING W R	(5) DESCRIPTION / (6) REMARKS	(7) OBSERVATION WELL DATA	(8) 'k' tod/rock cm/s / WATER PRESS TEST	(9) SPECIAL TESTS TYPE	RESULTS	NATURAL DENSITY kg/m³	MOISTURE CONTENT - %	(10) SHEAR STRENGTH kPa TYPE	RESULTS	(11) SPECIAL TESTS TYPE	RESULTS
1						FILL, silt (till), grey, some clay, some sand, little fine gravel, hard										
2		1A		89												
3		2A		40												
4						4.0 m FILL, fly ash, black, very dense											
		3A		91		4.6 m										
5						END OF BOREHOLE Note: Ground water sampling well installed to 4.6 m depth. (Top of well = 121.65 m)											

GEOTECHNICAL DATA SHEET — hole no 1B — Fig 7 — sheet 1 OF 1

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PROJECT CANADA BRICK QUARRY — HOLE TYPE FLYTE AUGER — OBSERVER MC

LOCATION SEE FIGURES 1 AND 5 — HOLE SIZE 4 1/2" — COMPILED CBC

DIP — DRILLED JULY 14/89 — CHECKED

DATUM 120.99 m — BEARING — DRAWN — APPROVED

BORING DATA						BORING LOG		WATER INF	FIELD TESTS		LABORATORY TESTS					
SCALE - METRES	ELEV / DEPTH	(1) SAMPLE NO	(2) SAMPLE TYPE	(3) 'N' VALUE per 0.3m / RQD - %	(4) WATER LEVEL and CAVING W R	(5) DESCRIPTION	(6) REMARKS	(7) OBSERVATION WELL DATA	(8) 'k' cm/s / WATER PRESS. TEST	(9) SPECIAL TESTS TYPE	(9) SPECIAL TESTS RESULTS	NATURAL DENSITY kg/m³	MOISTURE CONTENT - %	(10) SHEAR STRENGTH kPa TYPE	(10) SHEAR STRENGTH kPa RESULTS	(11) SPECIAL TESTS TYPE	(11) SPECIAL TESTS RESULTS
1						FILL, clayey silt (till), grey, some sand, little fine gravel, hard											
2		1A	X	51													
3		2A	X	50		3.65 m											
4						FILL, fly ash, black, very dense											
5		3A	X	70/0.25													
6		4A	X	109													
7						7.4 m											
8						END OF BOREHOLE											
						Note: Ground water sampling well placed to 7.4 m depth. (Top of well = 121.62 m)											

GEOTECHNICAL DATA SHEET — hole no 1C — Fig 8 — sheet 1 OF 1

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